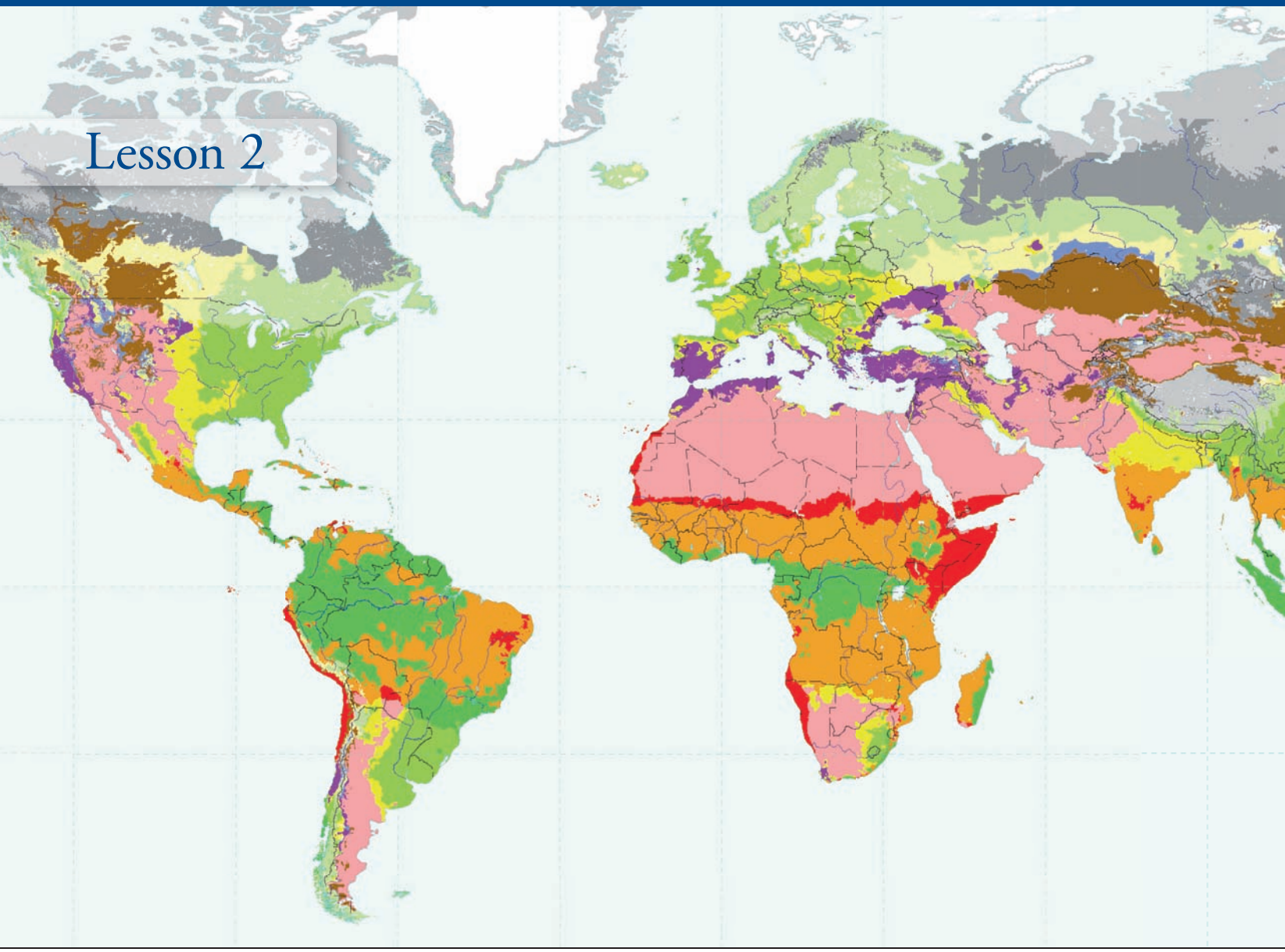
Lesson 2



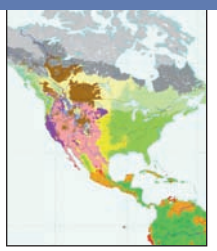
World biomes

What Makes a Biome?

Lesson 1 introduced students to two of the nine terrestrial biomes of the world. In this lesson, students explore all nine biomes and become familiar with the climates and locations that distinguish one biome from another.

Students compare a world biome map with a world climate map and discover the close correlation between the two. They graph rainfall and precipitation data for mystery locations and work in groups to match these climatograms to the biomes they characterize. Students identify the location of the biomes on a wall map and create a display that serves as a visual reminder of the range of each biome for the remainder of the unit.

Through graphing, mapping, and discussion, students learn to distinguish biomes by temperature, precipitation, latitude, and elevation. Students identify the location and climate for each of Earth's nine biomes. In Lesson 3, they will build on this chart by adding the characteristics of the vegetation in each biome.



Learning Objective

Recognize different biomes.

Identify the characteristics of various biomes.

Background

The distribution of biomes around the planet is closely associated with climate—long-term weather patterns for a region. A complex interaction of factors, including latitude (distance from the equator), topography (elevation), proximity to warm or cold ocean currents, and the influence of prevailing winds, determine climate. When looking at a map of the world's biomes, the influence of latitude, elevation, and proximity to coastlines is evident.

Each biome is limited in the range of latitudes in which it is found. Where multiple biomes are found at the same latitude, elevation or the influence of ocean currents usually explains the differences. For example, on the equator both rainforest and savanna occur at lower elevations, while the alpine biome occurs at higher elevations. The distribution of lower elevation biomes at similar latitudes reflects the influence of ocean currents, prevailing winds, and topography, such as the "rain-shadow effect" seen on the inland side of coastal mountain ranges and that results in a more arid climate.

Biomes are a human construct for categorizing large-scale patterns on Earth's surface. As there are no clear, hard boundaries in the natural world, identification of biomes and their ranges differs somewhat from source to source. Some sources list more than the nine biomes referenced here; for instance, they may split the rainforest biome into tropical and temperate. Others divide the Earth into a smaller list.

Climatograms are grids on which averages of precipitation and temperature at a particular location are plotted together. They provide a visual representation of the climate of a particular region. To plot both variables on the same graph, the left side of the graph is used as the axis for precipitation, and the right side is used as the vertical axis for temperature. To distinguish the two sets of data, temperature is plotted as a line graph and precipitation as a bar graph. Climatograms can be used to identify the characteristic climate for a biome in a particular location.

Key Vocabulary

Alpine: A biome located above the tree line that is characterized by extreme cold weather conditions. Worldwide, alpine biomes are found in high-altitude mountain regions.

Climate: The weather in an area averaged over a long period of time.

Climatogram: A graph that shows average temperature and precipitation each month for a given area.

Deciduous forest: A biome that is characterized by four distinct seasons and made up of trees that lose their leaves during winter (deciduous trees). Worldwide, deciduous forests are located at the middle latitudes.

Desert: A biome that is characterized by low rainfall and made up of plants and small animals that tolerate heat and long periods without water. Worldwide, most deserts are located at low latitudes and can be classified as hot and dry, semiarid, coastal, or cold.

Grassland: A biome made up of large areas dominated by short or tall grasses, and few trees or shrubs, such as the prairies on the Great Plains of the United States.

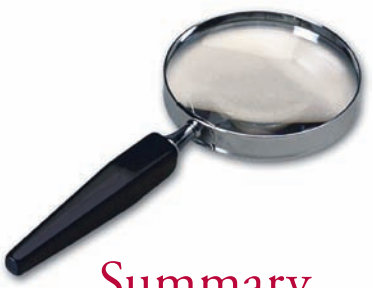
Precipitation: Water that falls from clouds to Earth as rain, mist, hail, sleet, ice, or snow.

Rainforest: A biome that is characterized by lush, diverse plant growth, and high amounts of rainfall. Worldwide, rainforests occur near the equator (tropical rainforests) and along the Pacific Coast (temperate rainforests).

Taiga: A coniferous forest biome that is characterized by long, cold, and dry winters and short, moist summers. Taiga is also called a boreal forest. Worldwide, it is found mainly in Russia and Canada.

Tundra/Polar: A biome made up of treeless plains, characterized by extremely low temperatures and little precipitation. Tundra is found near the North and South Poles..

Toolbox



Summary of Activities

Students explore the nine terrestrial biomes by constructing climatograms (temperature and precipitation graphs) and matching them with the appropriate biome descriptions. They compare world climate and world biomes maps and discover their correlation. They learn that climate, latitude, and elevation distinguish biomes.

Instructional Support

See Unit Resources, page 36

Prerequisite Knowledge

Students should be able to:

- create and read bar graphs and line graphs.

Advanced Preparation

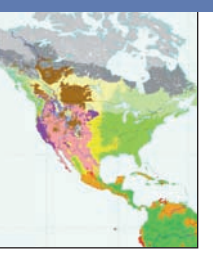
Gather and prepare Activity Masters.

Gather and prepare Materials Needed:

- Cut nine 18-to-20-inch lengths of string, one string for each biome.

Gather and prepare Visual Aids:

- Prepare transparencies.
- Cut apart the **Biome Cards**.
- Post the three posters of the **World Biomes** in a central location on the walls of the classroom. Locate the posters to allow space for posting the appropriate **Biome Cards** and climatograms that students create on their **Identify the Mystery Biome** activity masters. Also provide space for another information card will be added in Lesson 3. Leave them posted on the wall throughout the unit.
- Spread out the nine **Biome Cards** on a nearby worktable.
- Post the wall map of **Natural Regions**.



Materials Needed

Activity supplies:
- String or yarn: 15 feet per class

A-V equipment:
- Overhead or LCD projector, screen

Class supplies:
- Colored pencils or markers (two pencils each of two colors per group), graph paper, pushpins, transparency markers (two colors)

Unit Dictionary:
- Provided separately

Visual Aids

Photo Cards:
- **Biome Cards**, Visual Aids #5–9

Posters:
- **World Biomes: Taiga, Tundra/ Polar, and Alpine**, provided separately
- **World Biomes: Chaparral, Deciduous Forest, and Rainforest**, provided separately
- **World Biomes: Grassland, Savanna, and Desert**, provided separately

Transparencies:
- **World Biomes and Climates**, Visual Aid #3
- **Climatogram: Poway, California**, Visual Aid #4

Wall Maps:
- **Natural Regions**, provided separately

Duration

Preparation Time
40 min.
Instructional Time
60 min.

Safety Notes

None

Activity Masters in the Supporting Materials (SM)

Identify the Mystery Biome
SM, Pages 23–24
One per student

Mystery Biome Data Sheet
SM, Pages 25–26
One per student

World Biomes Task Sheet
SM, Pages 27–30
One per student

Procedures

Vocabulary Development

Use the **Unit Dictionary** and the **Vocabulary Word Wall Cards** to introduce new words to students as appropriate. These documents are provided separately.

Step 1

Point out the three posters of **World Biomes** placed around the classroom and explain that, taken together, they show all nine of the world's land-based biomes: alpine, chaparral, deciduous forest, desert, grassland, rainforest, savanna (also called woodland or veldt), taiga (coniferous forest), and tundra/polar. Remind students they already studied one biome found in California. Ask students to name that biome. (*Chaparral*) Mention to the students that throughout the unit they will be adding to these maps and creating a **Biome Wall Display.**

Step 2

Project the top part and cover the lower portion of the transparency **World Biomes and Climates** (Visual Aid #3). Explain that the top map shows where the nine biomes occur in the world.

Step 3

Point out the wall map of **Natural Regions**, explain that it shows nine major types of natural vegetation communities in California. Mention that although there are nine natural vegetation types in California, not all exist on a scale large enough to be considered biomes. Explain that although California has nine natural vegetation types, the state includes only four biomes: alpine, chaparral, desert, and rainforest. Mention to students that it is only coincidental that there are nine natural vegetation communities in California and nine biomes in the world.

Step 4

Ask students and list responses on the board to the following questions:

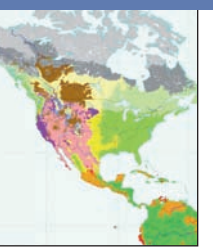
- What is the difference between a natural vegetation community (ecosystem) and a biome? (*A natural vegetation community is smaller and not found in other parts of the world.*)
- What makes one biome different from another? (*Climate and vegetation*)

Explain that they are going to examine the role of climate in determining different biomes by creating charts called climatograms.

Step 5

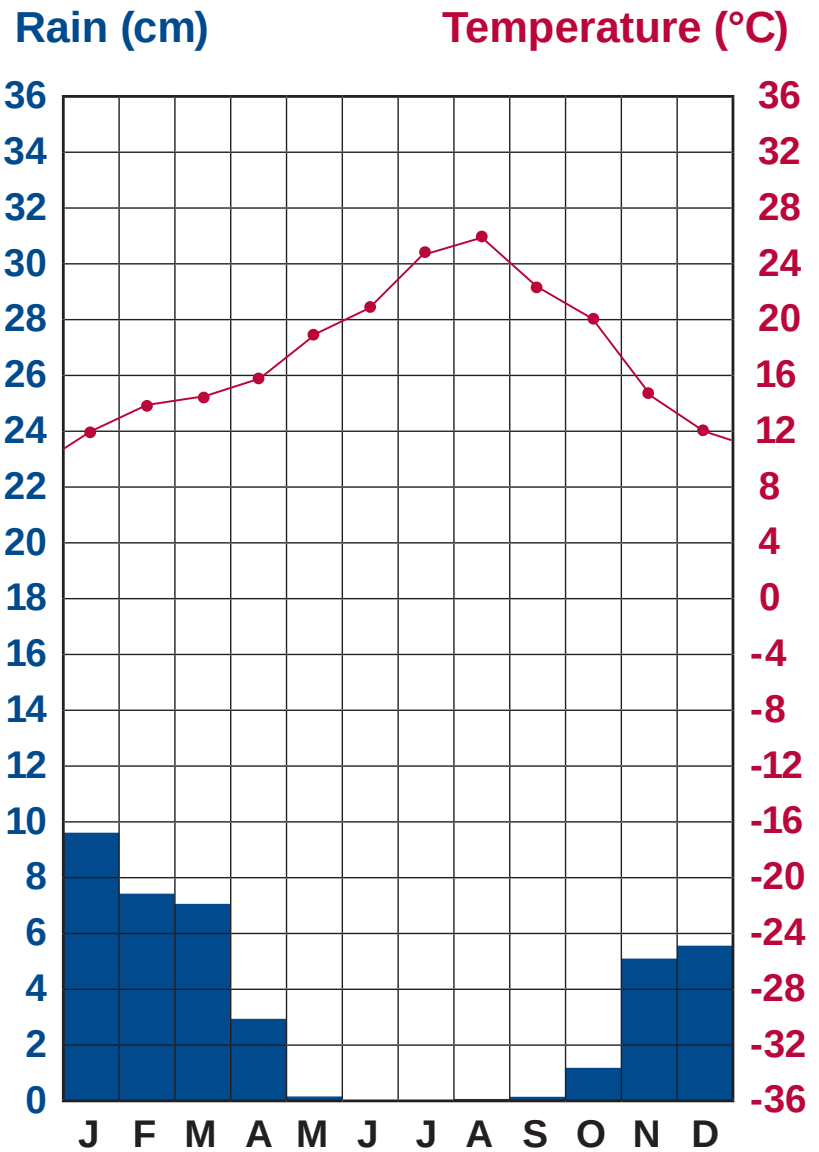
Uncover the bottom portion of the **World Biomes and Climates** transparency. Explain that the bottom map on the transparency presents the world's climates. Review with students the meaning of the terms "temperature" and "precipitation." Review with students the meaning of the term "climate" and explain that climate includes both temperature and precipitation.

Ask students, "How are biomes related to temperature, precipitation, climate?" (*The climates on the map match up very closely with the biomes on the map; they are closely correlated.*)



Step 6

Project the transparency **Climatogram: Poway, California** (Visual Aid #4). Explain that a climatogram is a graph that shows both temperature (as a line graph) and precipitation (as a bar graph) for a given area, in this case, the city of Poway in Southern California. Explain that the sample data table gives values for average temperature and average precipitation for each month of the year. Point out that the blank graph includes a scale for precipitation along the left axis and a scale for temperature along the right axis. Using the data provided, show students how to plot points for temperature on the graph. Connect the points to form a line graph. Then, using a second color, use the precipitation data to create a bar chart on the same graph.



Step 7

Organize students into nine groups, one for each of the nine terrestrial biomes. Assign each of the nine groups a different number between one and nine so that each group will be plotting data for a different biome. Distribute copies of **Identify the Mystery Biome** (Lesson 2 Activity Master) and **Mystery Biome Data Sheet** (Lesson 2 Activity Master). Explain that each group is to use the data on the **Mystery Biome Data Sheet** associated with their group number to graph a climatogram on the grid on the back of **Identify the Mystery Biome**. They should follow the procedures used in the demonstration of the climatogram for Poway. Teams work together, but each student should plot an individual climatogram.

Step 8

When students are finished creating their climatograms, explain that each group's climatogram represents the climate of one particular biome. Give each group a piece of string and four pushpins. Ask each group to match its climatogram with one of the nine **Biome Cards** (Visual Aids #5–9). Have groups pin their climatograms and appropriate photo cards to the wall and link them to the map with a piece of string. If students are having difficulty identifying the correct biome, suggest that they read the climate descriptions on the photo cards.

Step 9

After the class correctly labels all nine biomes, have each group summarize the climate and precipitation patterns for their biome for the rest of the class. Ask students to fill in the name of each biome on their **Mystery Biome Data Sheet**.

Ask students, "What makes the hotter biomes hotter and the colder biomes colder?" (*Latitude, or distance from the equator, elevation, and ocean current*) Suggest that students look at the patterns of biome distribution on the map. Ask students, "Are there any cold biomes found close to the equator?" (*Yes*) Ask students to explain why. (*High elevation*)

Step 10

Distribute the **World Biomes Task Sheet** (Lesson 2 Activity Master) and the **Unit Dictionary** and have students complete the assignment as homework. Explain that students are to read the **Unit Dictionary** and complete only Part 1 of the task sheet chart—the first two columns (location and climate). Students will complete the columns on plant characteristics during Lesson 3. Students may also use Internet resources to complete the assignment. Collect the **World Biomes Task Sheet** for use in assessment and in Lesson 3.

Lesson Assessment

Description

This lesson teaches students that biomes are closely associated with temperature and precipitation patterns—climate. Students create climatograms in Step 7 and match them to biome description cards in Step 8, demonstrating whether they understand this association for one biome. The **World Biomes Task Sheet** (Lesson 2 Activity Master) indicates whether students are able to recognize and describe all nine biomes.

Suggested Scoring

Identify the Mystery Biome (Lesson 2 Activity Master) is an ungraded assignment, but the climatograms should be checked for accuracy. Compare student graphs to the sample climatograms provided for each biome. Score the **World Biomes Task Sheet** (Lesson 2 Activity Master) by awarding 1 point per cell, for 18 possible points.

Identify the Mystery Biome

Lesson 2 Activity Master | *page 1 of 2*

Name: _____

Each of the world's nine biomes can be described by its climate and vegetation. Climate is the long-term weather pattern for a region. Temperature and precipitation (rain, snow, and sleet) are two ways to describe climate. Climatograms show temperature and precipitation on the same graph and provide a picture of a biome's climate.

Procedure

1. Find your team number on the **Mystery Biome Data Sheet**. Using the data for your team's mystery biome, plot the numbers for monthly temperature with dots. The scale for temperature is on the right side of the climatogram. Connect the dots to make a line graph. Then, with a second color, use the numbers for precipitation to plot a bar graph. The scale for precipitation is on the left side of the climatogram. Each team member should create their own climatogram.

2. Review the nine **Biome Cards** and use your chart to figure out which biome matches your data. Read the descriptions on the cards for clues.

3. Post one of your group's climatograms and the correct **Biome Card** on the wall near the map of **World Biomes**. Use a piece of string to connect your biome description card and climatogram to a spot in your biome's range on the map.

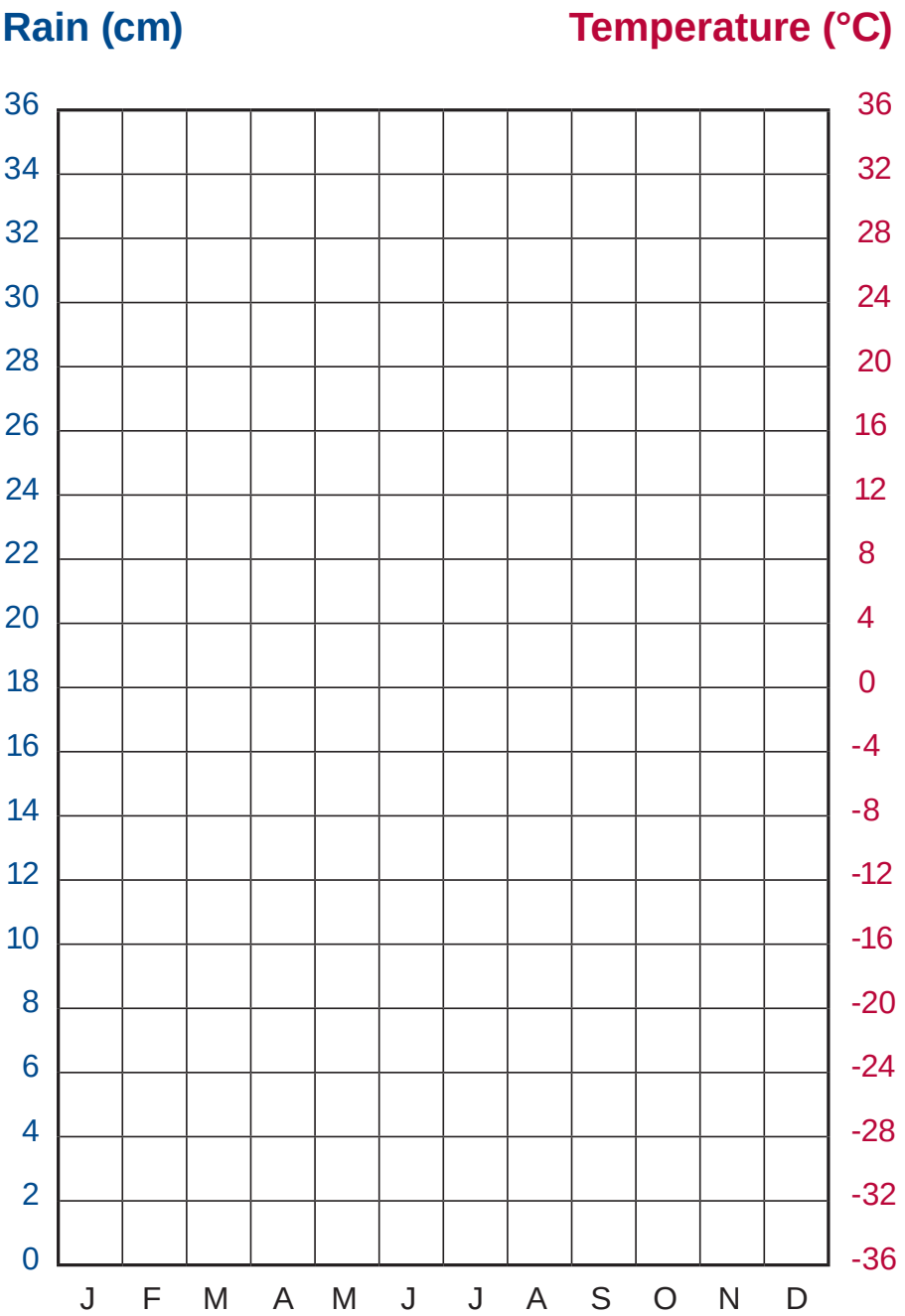
Answer Key and Sample Answers

Identify the Mystery Biome

Lesson 2 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome _____



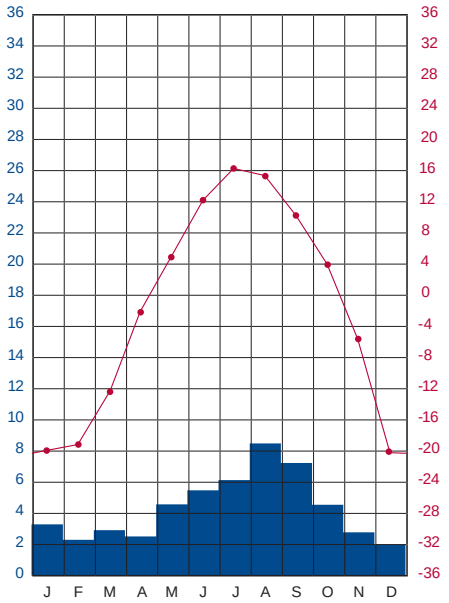
Answer Key and Sample Answers

Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#1 Taiga (Coniferous Forest): Ontario, Canada*

Rain (cm) **Temperature (°C)**

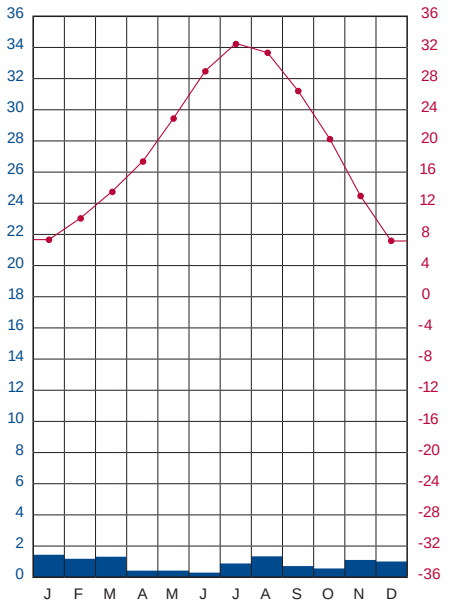


Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#2 Desert: Las Vegas, Nevada*

Rain (cm) **Temperature (°C)**

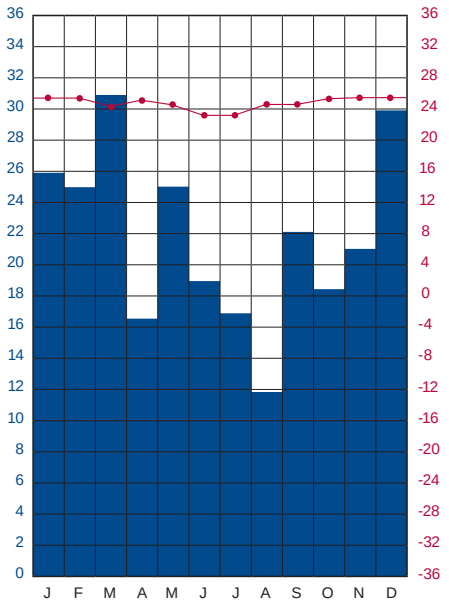


Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#3 Rainforest: Iquitos, Peru*

Rain (cm) **Temperature (°C)**

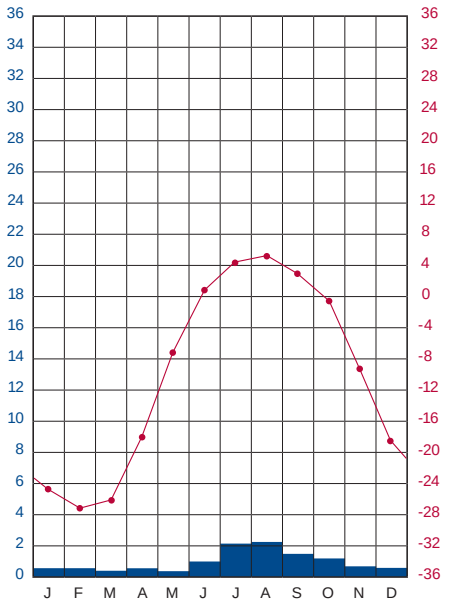


Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#4 Tundra: Barrow Alaska*

Rain (cm) **Temperature (°C)**

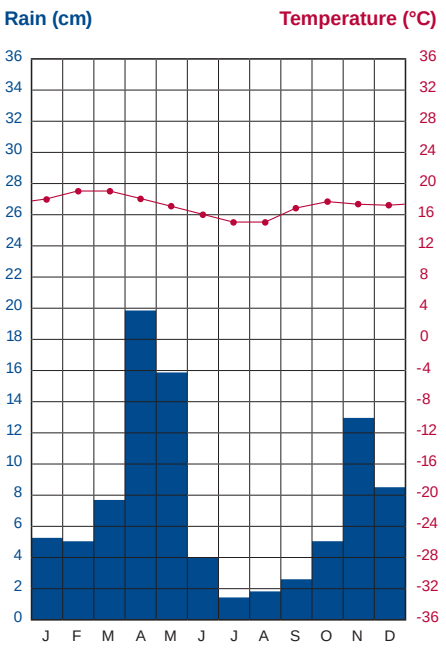


Answer Key and Sample Answers

Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

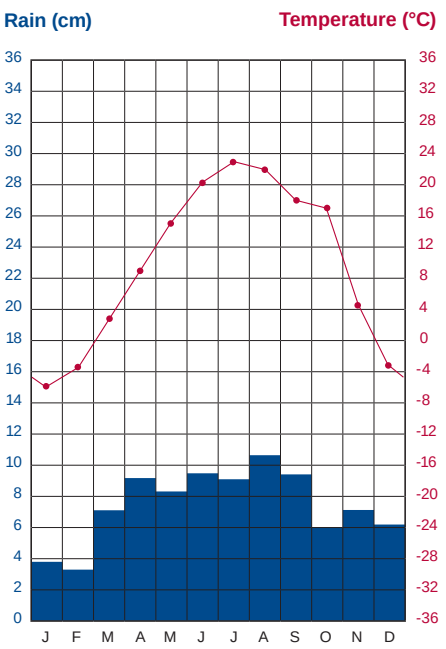
Climatogram: Mystery Biome *#5 Savanna: Nairobi, Kenya*



Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

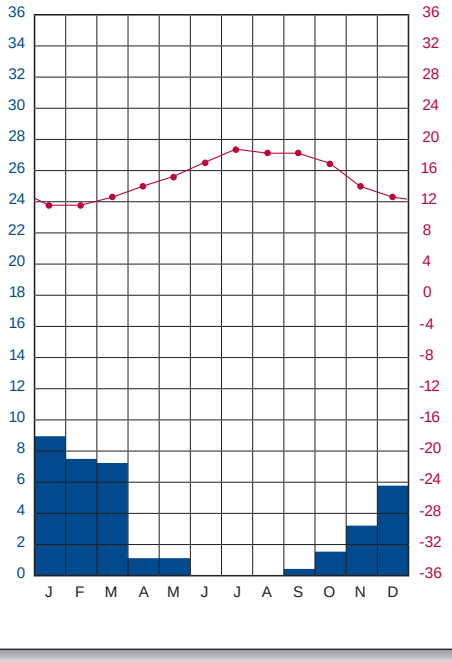
Climatogram: Mystery Biome *#6 Grassland: Northeastern Illinois*



Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

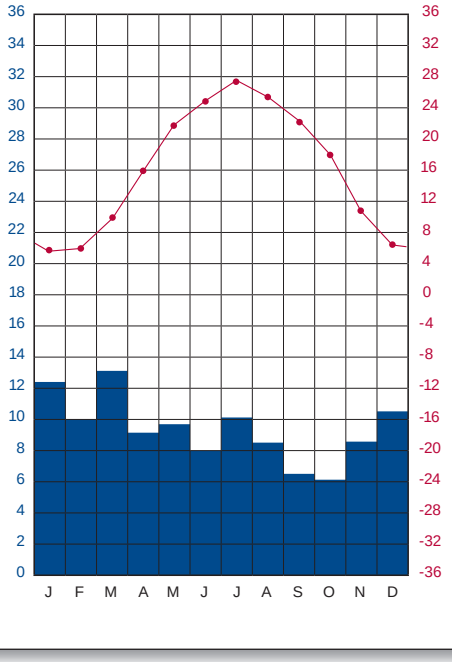
Climatogram: Mystery Biome *#7 Chaparral: Santa Monica, California*



Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#8 Deciduous Forest: Nashville, Tennessee*

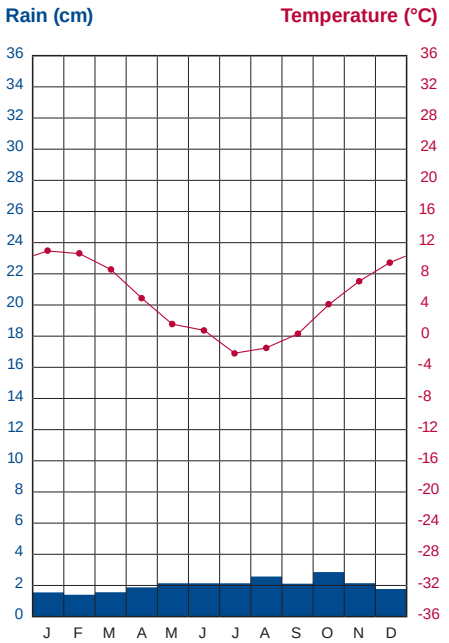


Answer Key and Sample Answers

Identify the Mystery Biome
Lesson 1 Activity Master | *page 2 of 2*

Name: _____

Climatogram: Mystery Biome *#9 Alpine: Charlotte Pass, Australia*



Answer Key and Sample Answers

World Biomes Task Sheet

Lesson 2 Activity Master | *page 1 of 4*

Name: _____

Part 1

Fill in the location and the climate boxes for each of the biomes listed. Use the **Unit Dictionary**, the classroom posters, and the Internet if it is available to help you. List two or more points in each box.

Part 2

As groups give their presentations, take notes and fill in the typical vegetation and plant characteristics boxes. List two or more points in each box. You may also add information to the location and climate boxes if you learn something new.

Note: *This assignment is completed over Lessons 2 and 3. Here the Answer Key only presents the answers for the part relevant to Lesson 2. The Lesson 3 answers are presented after Lesson 3.*

World Biomes Task Sheet

Lesson 2 Activity Master | *page 2 of 4*

Name: _____

	Location	Climate	Typical Vegetation	Plant Characteristics
Chaparral	*Middle latitudes* *Coastal areas of most continents* *Found in California foothills* *Covers 10% of California*	*Mild, wet winters* *Hot, dry summers* *Frequent fires*		
Savanna	*Subtropical* *Between forest or woodland and grassland or desert* *Covers large areas of India, Africa, Australia, and South America*	*Warm to hot* *Wet and dry seasons*		
Grassland	*Interior of continents in temperate latitudes* *Found in very large patches* *Flat land areas*	*Large temperature difference between summer and winter* *Rainfall amounts go up and down during the year* *Fire a natural part of ecosystem*		

Answer Key and Sample Answers

World Biomes Task Sheet

Lesson 2 Activity Master | *page 3 of 4*

Name: _____

	Location	Climate	Typical Vegetation	Plant Characteristics
Desert	*Hot deserts in California and southwest U.S., South America, Africa, Australia and Asia* *Further from the equator than grasslands and savanna* *Cold deserts in Antarctica and Greenland*	*Can be very hot or very cold* *Very little rain*		
Rainforest	*Tropical: near the equator* *Temperate: coastal California, Oregon, and Washington*	*Tropical: warm to hot and very high precipitation* *Temperate: warm to cool and humid, very high precipitation*		
Deciduous Forest	*Middle latitudes* *Most are located in the eastern United States, Canada, Europe, China, Japan, and parts of Russia.*	*Four distinct seasons* *Cold winters, warm summers* *Precipitation moderately high year-round*		

World Biomes Task Sheet

Lesson 2 Activity Master | *page 4 of 4*

Name: _____

	Location	Climate	Typical Vegetation	Plant Characteristics
Taiga (Coniferous Forest)	*Largest biome* *Found in a broad band across North America, Europe, and Asia, south of the Arctic tundra*	*Long, cold winters* *Mild, wet summers*		
Tundra/polar	*Found in the Arctic Circle and the Antarctic*	*Coldest of all biomes* *Frozen much of the year* *Very little precipitation*		
Alpine	*Found at all latitudes in high elevations (mountain areas)*	*Very cold in winter, mild during the short summer* *Gets colder at higher elevations*		

Answer Key and Sample Answers

Mystery Biome Data Sheet

Lesson 2 Activity Master | *page 1 of 2*

Name: _____

Mystery Biome #1: *Taiga (Coniferous Forest): Ontario, Canada*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	-20.0	-18.9	-12.2	-2.2	5.6	12.2	16.1	15.0	10.6	3.9	-5.6	-15.0
Precip (cm)	3.3	2.3	2.8	2.5	4.6	5.6	6.1	8.4	7.4	4.6	2.8	2.0

Mystery Biome #2: *Desert: Las Vegas, Nevada*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	7.5	10.6	13.5	17.8	23.3	29.3	32.8	31.5	26.9	20.1	12.7	7.6
Precip (cm)	1.4	1.2	1.3	0.5	0.5	0.3	0.9	1.3	0.7	0.6	1.1	1.0

Mystery Biome #3: *Rainforest: Iquitos, Peru*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	25.6	25.6	24.4	25.0	24.4	23.3	23.3	24.4	24.4	25.0	25.6	25.6
Precip (cm)	25.8	24.9	31.0	16.5	25.4	18.8	16.8	11.7	22.1	18.3	21.3	29.2

Mystery Biome #4: *Tundra: Barrow Alaska*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	-25.8	-27.8	-26.0	-18.2	-7.2	1.0	4.1	5.0	3.3	-0.8	-9.2	-18.1
Precip (cm)	0.4	0.4	0.3	0.4	0.3	0.8	2.2	2.3	1.5	1.3	0.6	0.5

Mystery Biome #5: *Savanna: Nairobi, Kenya*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	18.1	19.0	19.0	18.2	17.2	16.0	15.3	15.3	16.8	17.8	17.5	17.4
Precip (cm)	5.6	5.0	7.7	19.8	15.9	4.0	1.5	1.9	2.6	5.0	12.9	8.5

Mystery Biome Data Sheet

Lesson 2 Activity Master | *page 2 of 2*

Name: _____

Mystery Biome #6: *Grassland: Northeastern Illinois*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	-6.1	-3.7	2.9	9.2	14.9	20.3	22.9	22.1	18.0	17.1	4.4	-3.0
Precip (cm)	3.8	3.4	6.7	9.1	8.3	9.45	9.2	10.6	9.6	6.0	7.3	6.2

Mystery Biome #7: *Chaparral: Santa Monica, California*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	11.7	11.7	12.8	14.4	15.6	17.2	18.9	18.3	18.3	16.7	14.4	12.8
Precip (cm)	8.9	7.6	7.4	1.3	1.3	0	0	0	0.3	1.5	3.6	5.8

Mystery Biome #8: *Deciduous Forest: Nashville, Tennessee*

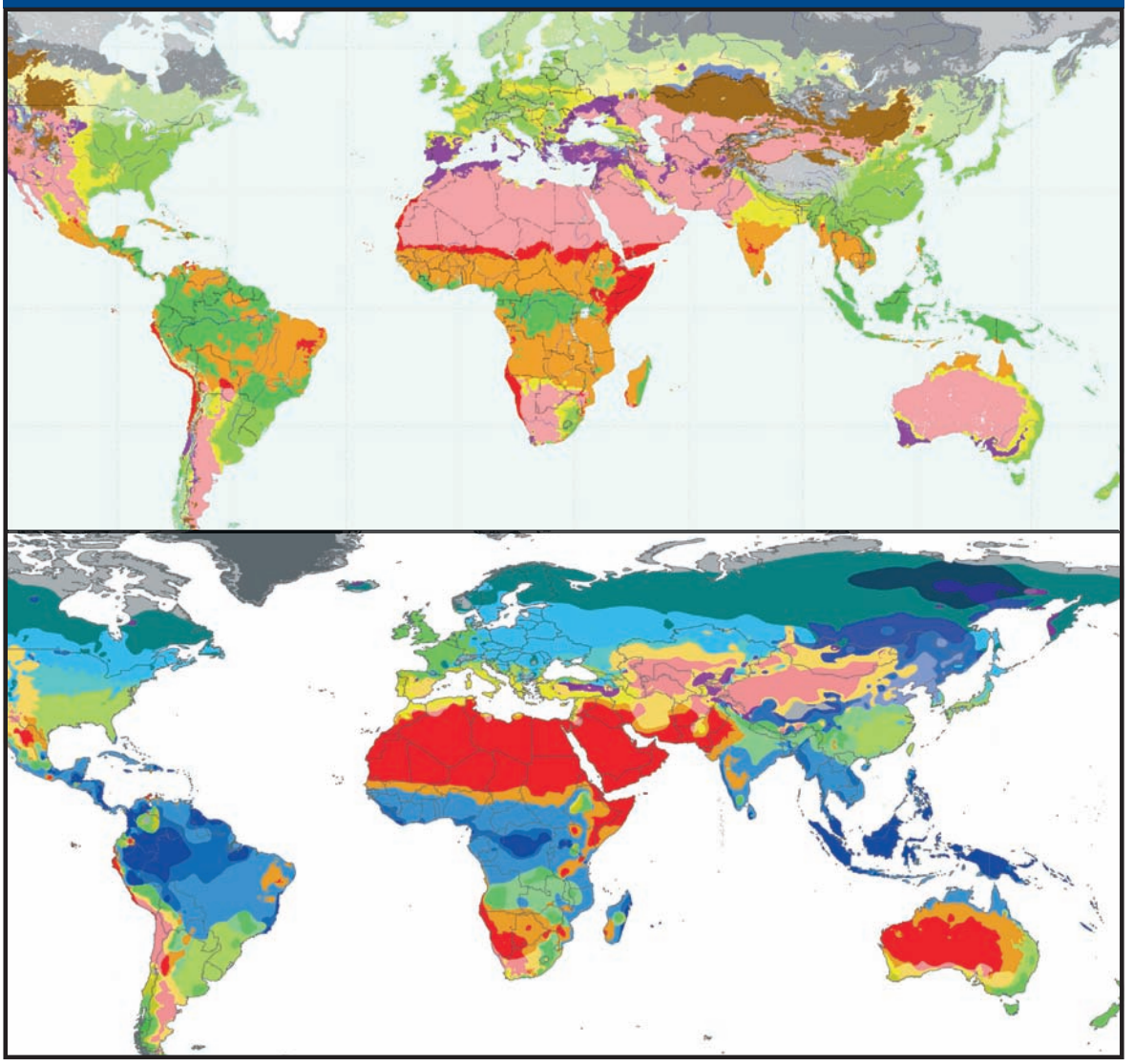
	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	5.8	6.0	10.0	16.0	21.8	25.1	27.8	25.6	22.3	18.0	10.8	6.5
Precip (cm)	12.5	10.0	13.3	9.3	9.7	8.0	10.1	8.3	6.5	6.1	8.4	10.5

Mystery Biome #9: *Alpine: Charlotte Pass, Australia*

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	11.1	10.9	8.6	4.8	1.7	1.3	-2.6	-1.7	0.4	4.1	7.0	9.4
Precip (cm)	1.5	1.4	1.5	1.8	2.1	2.1	2.1	2.4	2.1	2.7	2.1	1.7

3 **World Biomes and Climates**
Visual Aid — Transparency

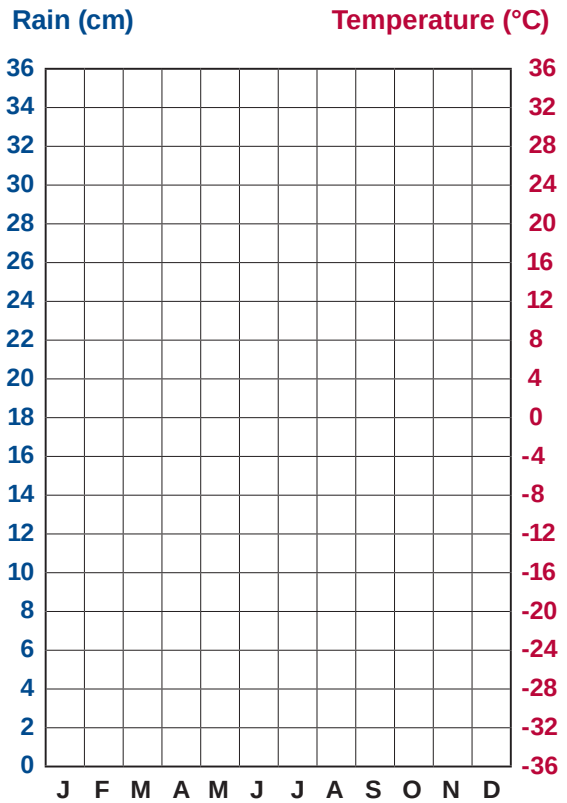
World Biomes and Climates



Climatogram: Poway, California

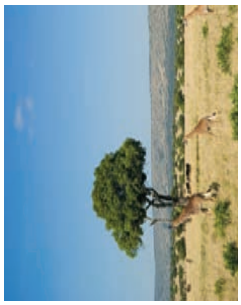
Average Monthly Temperature and Average Monthly Precipitation Data for Poway, California

	J	F	M	A	M	J	J	A	S	O	N	D
Temp (°C)	12.0	14.0	14.5	16.0	19.0	21.0	25.0	26.0	22.5	20.0	15.0	12.0
Precip (cm)	9.7	7.2	7.0	2.8	.1	.01	.05	.5	.1	1.3	5.3	5.5



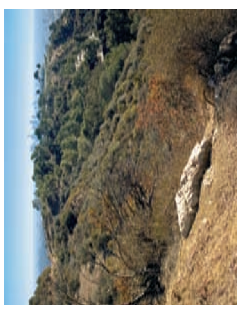
5 Biome Cards
Visual Aid — Photo Cards

Savanna



Location: Tropical, located between rainforests or woodlands and grasslands or desert.
Climate: Very warm with distinct wet and dry seasons; extreme changes in precipitation.

Chaparral



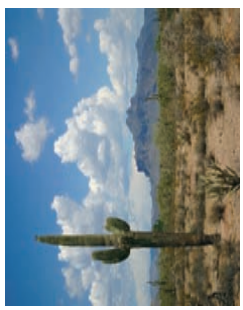
Location: Found in scattered patches in hilly coastal areas in the middle latitudes.
Climate: Mild, wet winters and hot, dry summers.

6 Biome Cards
Visual Aid — Photo Cards

Rainforest

Location: Tropical rainforests are found in a band along the equator, while temperate rainforests are found along coastlines.
Climate: Both tropical and temperate rainforests are warm and very humid with high rainfall that is usually heavier during a particular part of the year.

Desert



Location: Wide range, in tropical, subtropical, and temperate latitudes.
Climate: Very dry—average annual rainfall of 10 inches or less. Some are hot and dry while others are cold and dry.

7 Biome Cards
Visual Aid — Photo Cards

Taiga (Coniferous Forest)

Location: Covers most of inland Alaska, Canada (parts are called boreal forest), Northern Europe, and Russia (especially Siberia). The world's largest land-based biome.
Climate: Very large temperature change between summer and winter. Summers are short and humid, while winters are long and very cold. Low levels of precipitation, mostly in summer.

Deciduous Forest

Location: Middle latitudes.
Climate: Seasonal temperature changes and moderate precipitation that is spread evenly through the year.

8 Biome Cards
Visual Aid — Photo Cards

Alpine

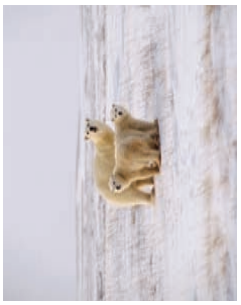
Location: At very high altitude (tall mountains and mountain ranges) at any latitude.
Climate: Very similar to tundra. Extremely cold and windy, with soils permanently frozen for much of the year at the highest elevations. Little precipitation.

Grassland

Location: In the interior of continents at middle latitudes.
Climate: Seasonal, with great differences in temperature between winter and summer. Moderate precipitation, heaviest in the spring.

9 **Biome Cards**
Visual Aid — Photo Cards

Tundra/Polar



Location: Arctic region, north of the taiga biome, and the Antarctic region.

Climate: Extremely cold, frozen for much of the year, and dry. Two seasons: winter and summer. In summer, the upper layer of the frozen ground defrosts and marshes, lakes, and streams cover the land. There are, in effect, two layers of soil.